Import Competition and Firms' Internal Networks

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CES 21-28 **September 2021**

Abstract

Using administrative data on U.S. multisector firms, we document a cross-sectoral propagation of the import competition from China ("China shock") through firms' internal networks: Employment of an establishment in a given industry is negatively affected by China shock that hits establishments in other industries within the same firm. This indirect propagation channel impacts both manufacturing and non-manufacturing establishments, and it operates primarily through the establishment exit. We explore a range of explanations for our findings, highlighting the role of within-firm trade across sectors, scope of production, and establishment size. At the sectoral aggregate level, China shock that propagates through firms' internal networks has a sizable impact on industry-level employment dynamics.

Keyword*:* China shock, import competition, multisector firms, multiproduct firms, network propagation, trade

JEL Classification: D22, F14, F40

[*]We thank Daron Acemoglu, Rodrigo Adao, Steve J. Davis, Jonathan Dingel, Andres Drenik, Kilian Huber, Stephanie Schmitt-Grohé, Bradley Setzler, Peter Schott, Gustavo de Souza, Felix Tintelnot, Martín Uribe, Thomas Winberry, and Oren Ziv for their feedback. We thank participants in the Macro Lunch seminar at the University of Chicago (Dec 2019), the 2020 Academy of Economics and Finance, WEAI, the 2021 European Meeting of the Urban Economics Association, Aarhus University workshop, the Econometric Society Asian Meeting, and the Econometric Society Chinese Meeting. Any views expressed are those of the authors and not those of the U.S. Census Bureau. The Census Bureau's Disclosure Review Board and Disclosure Avoidance Officers have reviewed this information product for unauthorized disclosure of confidential information and have approved the disclosure avoidance practices applied to this release. This research was performed at a Federal Statistical Research Data Center under FSRDC Project Number 2012. (CBDRB-FY21-P2012-R9023). This paper was previously circulated under the title "Import Competition and Firms' Internal Networks: An Establishment-level Analysis".

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1 Introduction

The precipitous decline of U.S. manufacturing employment over the last several decades has stirred active discussion among both academics and policymakers.[1] The rising import competition from developing economies—especially from China—has been identified as one of the main factors that accounts for this phenomenon.[2] Indeed, the growth of China and its integration into global trade has marked one of the most important changes in the world economy of the last two decades: The share of world manufacturing exports that originate in China increased from 2 percent in 1990 to 12 percent in 2007, and increased further to 16 percent in 2011. Previous research found a robust and significant negative impact of the rising import competition from China ("China shock") on manufacturing employment at the regional (Autor et al., 2013), sectoral (Asquith et al., 2019), worker (Autor et al., 2014), and establishment levels (Pierce and Schott, 2016; Park, 2020).

The extent to which China shock matters in the aggregate has been shown to depend on various indirect channels, including input-output networks (Acemoglu et al., 2016a; Pierce and Schott, 2016; Park, 2020) and agglomeration externalities (Helm, 2020). However, this literature has overlooked the role played by multisector firms that account for 71% of the total manufacturing employment and 25% of the overall employment in the U.S. economy.[3] Consider a firm that owns multiple establishments that operate in different sectors. Since the exposure to import competition from China varies across sectors, establishments in a given industry will be affected by Chinese import competition more or less strongly than establishments that operate in other sectors. It is not clear how ex ante plant-level employment will respond to the rising import competition from China. On the one hand, the firm could reallocate workers from more to less affected (or unaffected) establishments, thereby increasing employment in the latter. On the other hand, employment at all plants can be reduced because of dampened general production at the firm-level (for example, due to within-firm complementarities in

[1] The fraction of the U.S. working-age population employed in manufacturing declined by one-third—from 12.6 percent to 8.4 percent—between 1991 and 2007, and the number of manufacturing jobs declined by 5.8 million between 2000 and 2010.

[2] Fort et al. (2018) provides the overview of the literature on the U.S. manufacturing employment decline.

[3] These statistics are based on multisector firms that operate at least one manufacturing establishment.

production or financial constraints). Finally, establishments with no direct exposure to import competition from China might not be affected at all if plants operate independently.

To shed light on how multisector firms respond to rising import competition from China, we construct our key independent variable—an indirect shock at the establishment-level. This variable represents an average exposure to China shock that arises from establishments that operate in other industries *within* the same firm. To disentangle the impact of the indirect shock from the plant's exposure to the rising import competition from China, we also control for direct China shock.[4] Furthermore, to remove the demand-driven part of the rising competition from China, we follow Autor et al. (2014) and instrument both direct and indirect shocks using the growth in import penetration from China to other high-income countries. Our analysis reveals that the rising import competition from China propagates through within-firm internal networks and reduces employment of plants that operate in other sectors within a firm, including those which are not directly exposed to China shock. This novel indirect propagation channel affects both manufacturing and non-manufacturing establishments, and it is quantitatively stronger than the direct effect of China shock.

We base our analysis on the sample of U.S. multisector firms sourced from the Longitudinal Business Database (LBD), an administrative dataset housed by the U.S. Census Bureau. Our main analysis focuses on the time period 1991-2007. The LBD is the most comprehensive dataset on the U.S. private business sector, which covers the universe of non-farm establishments that have at least one paid employee (Jarmin and Miranda, 2002; Chow et al., 2021). Critically for our analysis, each establishment in the LBD is associated with a firm identifier, which allows us to identify the set of establishments that constitute each firm.[5]

We perform a number of robustness exercises to corroborate our main finding. For instance, we conduct several Placebo tests to check whether our results are driven by pre-existing trends and counterfactual firm networks. Furthermore, we confirm that there is no significant correlation between direct and indirect China shocks. The results are robust to

[4]Direct China shock measures the growth of import penetration from China to the U.S. between 1991 and 2007.

[5]The establishment identifier `lbdnum` is not reused when an establishment exits or goes inactive, thereby allowing for longitudinal links between different snapshots of the LBD.

controlling for disaggregated industry fixed effects (up to SIC 8-digit level) and numerous other within-firm characteristics. We also check robustness with respect to outliers, firm affiliation and industry switchers. Moreover, we demonstrate that our baseline two-way clustering of standard errors is conservative in the respect that shift-share robust standard errors are smaller. Several additional robustness checks are also described in the robustness section.

We then explore whether our results are accounted for by establishment exit or the contraction of continuing plants. To do this, we decompose the establishment-level employment growth into extensive and intensive margins. The data reveal that the negative impact of indirect shock is primarily driven by the extensive margin of employment adjustment. This result is consistent with the finding that China shock affects U.S. employment mainly through establishment exit (Asquith et al., 2019). Therefore, we contribute to the literature by showing that establishment exit in a given industry surges when other industries in which the firm operates become more exposed to rising import competition from China. Additionally, noting that the entry margin in our sample is statistically and economically insignificant, we argue that it is not the case that multisector firms adjust to China shock by opening new plants.

In order to shed more light on the workings of the within-firm propagation of the trade shock, we explore several potential mechanisms. First, we highlight the role played by input-output linkages between establishments within a firm. The data support the view that plants that use more inputs from other establishments within a firm respond more strongly to indirect China shock. This finding is compatible with the idea that downstream industries lose relation-specific production when the industries from which they receive inputs become exposed to the trade shock. Furthermore, we evaluate the role of economies of scope—a firm-level characteristic that several recent papers emphasize (Argente et al., 2020; Ding, 2020)—and find that plants in firms with a larger scope accommodate the indirect shock more easily. Moreover, we provide empirical evidence that larger establishments respond more strongly to the indirect China shock. This occurs because such establishments are likely to be mass-product oriented and, thus, face tougher competition from China (Holmes and Stevens, 2014). We also explore the role of financial constraints and capital- and skill-intensities, but we do not find empirical

support for these channels.

Finally, we study whether China shock, propagated through firms' internal networks, induces industry-level employment changes. In general, industry-level adjustments caused by the indirect shock could be muted if workers, who were laid off because of the indirect shock, are hired by other establishments that operate in the same industry. To account for this possibility, we define industry-level employment as the total employment of all plants in a given industry, including those that belong to single-sector firms. We find that indirect China shock causes a significant decline in the industry-level employment growth; consistent with the establishment-level result, plant exit accounts for most of the adjustment. For manufacturing industries, the overall employment response (including establishment exit, entry and the intensive margin) is found to be significant, although we only find a significant effect for the exit margin when all industries are considered (including the non-manufacturing sector).

Related Literature Our work is related to several strands of the literature. First, we contribute to the literature that studies spillover effects that propagate through firm networks. Examples include Giroud and Mueller (2019) and Hyun and Kim (2020), who explore region-level shocks, and Cravino and Levchenko (2017), Berman et al. (2015), Almunia et al. (2018), Boehm et al. (2019), who focus on the cross-country propagation of shocks.[6] We complement this literature by studying the propagation of *sector-level* shocks through internal networks of *multisector* firms.

Second, we contribute to the influential literature that examines the role that multiproduct firms play in the macroeconomy (e.g., Lach and Tsiddon, 1992), international trade (e.g., Bernard et al., 2011, Bernard et al., 2010, Eckel and Neary, 2010), and organizational theory (e.g., Teece, 1982). Our analysis reveals that multiproduct firms are important for the propagation of sectoral shocks.[7]

[6] On a high level, we contribute to the literature which studies how shocks propagate through networks. That broad literature studies input-output (Acemoglu et al., 2016a; Acemoglu et al. 2016b), within-region and cross-industry (Helm, 2020), financial (Cabrales et al., 2017), and social networks (Bailey et al., 2018).

[7] Ding (2020) provides another relevant recent study of multi-industry firms in the manufacturing sector. Given his focus on manufacturing multi-industry firms with at least one industry that directly exports, his sample is more than 12 times smaller than ours; in large part because it is comprised of very large manufacturing businesses.

Third, we contribute to the growing literature on the U.S. manufacturing employment decline (see Fort et al., 2018 and Abraham and Kearney, 2018 for the overview). This line of research identifies automation and import competition as key factors that account for this secular pattern. Our paper offers a new channel through which increasing import competition from China can negatively affect the U.S. manufacturing sector.

Finally, our work contributes to the literature on "China shock," which has had an immense economic, social, and political impact on the U.S. and other developed countries. Previous work has documented the significant impact of this shock on manufacturing employment (Autor et al., 2013, Pierce and Schott, 2016, Asquith et al., 2019, Bloom et al., 2019), the earnings of affected workers (Autor et al., 2014), and firms' R&D and investment (Autor et al., 2016, Pierce and Schott, 2018). The literature has also evaluated the impact of the rising competition from China on various business-level adjustments (Park, 2020), political polarization and Trump's election (Autor et al., 2020), Brexit (Colantone and Stanig, 2018), and childhood poverty and single motherhood (Autor et al., 2019). Our work is unique in that we apply the concept of within-firm networks to this literature and argue that the impact of China shock could be much stronger than previously thought.

The rest of this paper is organized as follows. Section 2 lays out our empirical strategy. Section 3 describes the dataset. Section 4 presents our main establishment-level results. In Section 5, we show that the indirect effect of China shock is preserved at the sector level. Section 6 concludes.

2 Empirical Strategy

In this section, we describe how both direct and indirect China shocks are measured and outline our main empirical specification.

2.1 Measuring Import Competition with China

We follow Acemoglu et al. (2016a) (hereafter AADHP) and measure each establishment's direct exposure to China shock by its industry-level increase in the import penetration from China

between 1991 and 2007.[8] AADHP measure the direct exposure of industry j to the import competition from China as

$$\widetilde{\Delta} IP_{j,91-07} = \frac{\Delta M^{UC}_{j,91-07}}{Y_{j,91} + M_{j,91} - E_{j,91}}. \tag{2.1}$$

In Equation (2.1), $\Delta M^{UC}_{j,91-07}$ denotes the change in real imports from China to the U.S. between 1991 and 2007 in industry j, and $Y_{j,91} + M_{j,91} - E_{j,91}$ is the real domestic absorption of industry j in year 1991 measured as the sum of industry shipments $Y_{j,91}$ and industry imports $M_{j,91}$ less industry exports $E_{j,91}$. The measure of direct exposure (2.1) is available for 392 manufacturing industries at the SIC 4-digit level.

A group of establishments that operate in industry j share the same direct exposure to China shock. Therefore, if an establishment b owned by firm f has an industry code j, then that establishment's direct exposure to import competition from China equals the direct exposure of industry j:

$$\widetilde{\Delta} IP^{b,f}_{j,91-07} = \widetilde{\Delta} IP_{j,91-07}. \tag{2.2}$$

It is critical for our analysis to isolate a part of the import competition that is accounted for by the rising Chinese supply from the U.S. demand shock. Arguably, an increase in Chinese imports was to a large extent exogenous to the U.S.: The Chinese productivity surge in the late 1980s and early 1990s came about mostly as a result of internal Chinese economic and political reforms. In other words, it occurred because reformists gained power through the power struggle within the Communist Party of China, a process which was exogenous to the U.S. demand shock.

That said, the rising import penetration from China may still have been caused by U.S. internal demand. To assuage this concern, we follow the lead of ADHS and AADHP and instrument $\widetilde{\Delta} IP_{jt}$ by the measure of import penetration from China to other high-income countries:

[8] Following Acemoglu et al. (2016a) and Asquith et al. (2019), we also consider two subperiods, 1991-1999 and 1999-2007, and find similar results. See Tables A.11 and A.12 in Appendix A.2.

$$\widetilde{\Delta} IPO_{j,91-07} = \frac{\Delta M^{OC}_{j,91-07}}{Y_{j,88} + M_{j,88} - X_{j,88}}, \tag{2.3}$$

where $\Delta M^{OC}_{j,t}$ is the change in real imports from China to other high-income countries between 1991 and 2007 in industry j and $Y_{j,88} + M_{j,88} - X_{j,88}$ is the real domestic absorption in year 1988.[9] Applying the same logic as before, establishments that operate in the same industry j—regardless of the firm they belong to—share the same direct exposure to China shock:

$$\widetilde{\Delta} IPO^{b,f}_{j,91-07} = \widetilde{\Delta} IPO_{j,91-07}. \tag{2.4}$$

2.2 Indirect China Shock and Within-firm Sectoral Networks

Consider an establishment b in industry j owned by a firm f. Our objective is to investigate how establishment-level employment responds to import competition that hits other establishments in the same firm. Similar to Giroud and Mueller (2019) and Hyun and Kim (2020), who study indirect local demand shock that arises from within-firm regional networks, we construct the within-firm indirect China shock as follows:

$$\widetilde{\Delta} IP^{f}_{j,91-07} \text{ (other)} = \sum_{j' \neq j} \omega^{f}_{j',-j,91} \times \widetilde{\Delta} IP_{j',91-07}, \tag{2.5}$$

where $\omega^{f}_{j',-j,91} \equiv \frac{Emp^{f}_{j',91}}{\sum_{j'' \neq j} Emp^{f}_{j'',91}}$ is a share of the within-firm employment accounted for by industry $j' \neq j$ at the start of the period (year 1991). Note that firm f's employment in industry j is not taken into account when we construct this weight.[10] Thus, $\widetilde{\Delta} IP^{f}_{j,91-07}$ (other) can be viewed as a weighted average of China shock that hits firm f through its establishments operating in industries other than j.

[9] The list of other advanced economies includes Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland.

[10] Some firms own both manufacturing and non-manufacturing establishments. When we construct $\widetilde{\Delta} IP^{f}_{91-07}$(other), we assign $\widetilde{\Delta} IP^{b,f}_{j,91-07} = 0$ to non-manufacturing establishments. This does not pose a serious problem because we control both for the firm-level manufacturing employment share and the firm-level employment share of other establishments. Moreover, our results hold when we include only manufacturing employment in the denominator of the weight: $\omega^{f}_{j',-j,91} \equiv \frac{Emp^{f}_{j',91}}{\sum_{(j'' \neq j)\&(j'' \in \mathbf{Mfg})} Emp^{f}_{j'',91}}$. See discussion in Section 4.2.

In our main empirical analysis, we instrument $\widetilde{\Delta}IP^{f}_{j,91-07}$ (other) using $\widetilde{\Delta}IPO^{f}_{j,91-07}$ (other) defined as:

$$\widetilde{\Delta}IPO^{f}_{j,91-07}\text{ (other)} = \sum_{j' \neq j} \omega^{f}_{j',-j,91} \times \widetilde{\Delta}IPO_{j',91-07}. \tag{2.6}$$

2.3 Dependent Variable

Our main dependent variable measures establishment-level employment growth. We use the arc-growth rate measure proposed by Davis et al. (1996), which is routinely used with establishment- and firm-level data. The employment growth of an establishment b owned by a firm f between years 1991 and 2007 is defined as:

$$\widetilde{\Delta}Emp^{b,f}_{91-07} = \frac{Emp^{b,f}_{07} - Emp^{b,f}_{91}}{\frac{1}{2}\left(Emp^{b,f}_{91} + Emp^{b,f}_{07}\right)}, \tag{2.7}$$

where $Emp^{b,f}_{t}$ denotes employment of the establishment b at time t. This measure is symmetric around 0 and is bounded between -2 and 2: These features reduce the impact of outliers with no arbitrary winsorization of extreme observations.[11] Also, this measure allows for a unified treatment of establishment entry and exit (in these cases, the arc-growth measure equals 2 and -2, respectively).

2.4 Empirical Specification

Our baseline empirical specification takes the following form:

$$\widetilde{\Delta}Emp^{b,f}_{91-07} = \beta_0 + \beta_1 \widetilde{\Delta}IP_{j,91-07} + \beta_2 \widetilde{\Delta}IP^{f}_{j,91-07}\text{ (other)} + \beta_3' \mathbf{X}^{b,f}_{j,0} + \delta^{b,f}_{j} + \varepsilon^{b,f}_{j,91-07}, \tag{2.8}$$

where $\mathbf{X}^{b,f}_{j,0}$ is a vector of establishment- and firm-level controls, and $\delta^{b,f}_{j}$ denotes a set of various fixed effects. While coefficient β_1 measures the direct impact of China shock on the establishment-level employment growth, coefficient β_2, which is the main coefficient of interest, captures the indirect impact of China shock that arises through within-firm sectoral networks.

[11] Technically, this measure is a second-order approximation of the log-difference growth rate around 0.

The vector of controls $\mathbf{X}_{j,0}^{b,f}$ includes logarithms of the initial establishment- and firm-level employment, quadratic polynomials in establishment and firm age, and the within-firm share of manufacturing employment.[12] Also, to account for the size of a given establishment relative to other establishments within the firm, we include the logarithm of average initial employment in the other establishments that constitute that firm. In specifications in which we only consider manufacturing establishments, we additionally include manufacturing industry controls sourced from AADHP: capital over value added, computer as a share of investment, and high-tech equipment as a share of investment (all measured in 1991).

The set of fixed effects $\delta_j^{b,f}$ includes county- and sector fixed effects. County fixed effects control for any common trends in the establishment-level employment growth within each county, thereby absorbing any regional shocks or general equilibrium adjustments at the county level. In turn, sector fixed effects control for any sectoral trends in the establishment growth. We consider sector fixed effects at the SIC 2- and 4-digit levels.[13] Provided that China shock is defined at the SIC 4-digit level, we exclude the direct China shock in the case of the SIC 4-digit level sector fixed effects.

All regressions are weighted by the initial establishment-level employment, although the results are robust to unweighted regressions (see Section 4.2). Throughout the analysis, standard errors are two-way clustered at the state and firm levels, allowing for an arbitrary correlation in error terms among establishments in the same state and/or sector.[14] In IV regressions, we report Kleibergen and Paap (2006) F-statistics when there is a single instrumented variable (e.g., specifications with an indirect shock and SIC 4-digit fixed effects), and Sanderson and Windmeijer (2016) F-statistics whenever we instrument multiple variables simultaneously (e.g., specifications with both direct and indirect shocks along with SIC 2-digit fixed effects).

[12] Firm age equals the age of the oldest establishment within the firm.

[13] We also consider more disaggregated sector fixed effects up to SIC 8-digit level using the National Establishment Timeseries Database (NETS) and find robust results—see the discussion in Section 4.2.

[14] We experiment with shift-share robust standard error as in Adao et al. (2019), and find them to be slightly smaller than those under the two-way clustering (see discussion in Section 4.2). We also consider alternative clusterings, such as state-and-sector, state, firm, and sector. The precision of estimates does not vary much across these alternative specifications.

3 Data

3.1 Longitudinal Business Database

Our main data source is the LBD housed by the U.S. Census Bureau. The LBD is an administrative panel dataset that covers the universe of non-farm establishments in the U.S. private sector with at least one paid employee (Jarmin and Miranda, 2002; Chow et al., 2021). The unit of observation is an establishment, which is defined as a single physical location where business is conducted. The establishment identifier `lbdnum`—which is robust to mergers and acquisitions—allows us to track establishments over time. Critically, each establishment in the LBD is associated with a firm key `firmid`: We use this information to identify a set of plants that constitute each firm.

Provided that the U.S. underwent a transition from the SIC to NAICS standard in 1997, we rely on the consistent (across years) NAICS 2012 industry classification constructed by Fort and Klimek (2016) (variable `fk_naics12`). Furthermore, when we need to obtain SIC 1987 industry codes, we use industry crosswalks compiled by Eckert et al. (2021).

3.2 Summary Statistics

Our analysis is restricted to multisector firms that operate at least one manufacturing establishment. Thus, both manufacturing and non-manufacturing establishments are included in the sample.[15] Our final sample accounts for 71% of total manufacturing employment and 25% of overall employment in the U.S. economy. We focus on the time period between 1991 and 2007 in our main analysis and examine the period 1976-1991 in a pre-trend analysis. The sample is restricted to establishments that were active in 1991.[16]

Table 1 provides summary statistics for our core sample. At the establishment level, we observe that more than one-half of establishments exited during the period 1991-2007, highlighting the importance of the exit margin. We find sufficient variation across establishments

[15] For example, a firm with two establishments, one that operates in a manufacturing industry and the other in a non-manufacturing industry, is included in our sample.

[16] We do not require establishments to be active in 2007, thereby accommodating the exit margin.

Table 1: Summary Statistics

Establishment-level						
Variable	Obs.	Mean	Std. Dev.	P10	P50	P90
$\widetilde{\Delta}\text{Emp}_{(91-07)}$	573,000	-1.368	1.012	-2	-2	0.314
$\widetilde{\Delta}\text{IP}_{(91-07)}$	573,000	0.104	0.462	0	0	0.150
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	573,000	0.201	0.332	0	0.030	0.759
Emp 1991	573,000	46.3	227.7	2	9	94
Firm-level						
Variable	Obs.	Mean	Std. Dev.	P10	P50	P90
Emp 1991	62,000	426.6	5389	6	22	360
Num. of Sectors 1991	62,000	3	3.1	2	2	4
Num. of Manu. Sectors 1991	62,000	1.4	1.6	1	1	2
Num. of Non-Manu. Sectors 1991	62,000	1.6	2	1	1	3
Num. of Establishments 1991	62,000	9.2	125.9	2	2	8
Num. of Manu. Establishments 1991	62,000	1.9	6.1	1	1	3
Num. of Non-Manu. Establishments 1991	62,000	7.3	124.4	1	1	5

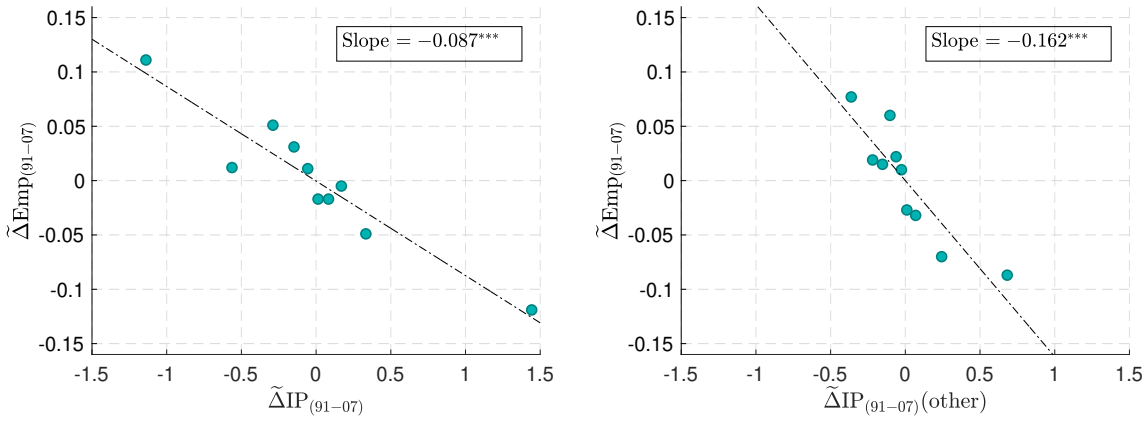
Notes: This table provides summary statistics for the final sample at the establishment and firm levels. The sample is sourced from the U.S. Census Longitudinal Business Database (LBD) and consists of multisector firms that operate at least one manufacturing establishments. The sample contains both manufacturing and non-manufacturing establishments. $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the establishment-level employment growth, $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock, and $\widetilde{\Delta}\text{IP}_{(91-07)}$(other) is the indirect China shock. See Section 2 for a detailed description of variables. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

in terms of their exposure—both direct and indirect—to import competition from China.[17] Provided that the average establishment is much larger than the typical plant (46 and 9 workers, respectively), the establishment size distribution is highly right-skewed.

At the firm level, the average size is 427 workers with the median of 22 employees. Also, an average firm operates in three sectors (at the SIC 4-digit level) and has nine establishments, of which two are classified as manufacturing and seven as non-manufacturing. However, these distributions are also right-skewed: The typical firm operates just two plants with one establishment in each sector. Table A.1 in Appendix reports summary statistics at the sectoral level.

[17] The direct China shock is zero for non-manufacturing establishments by construction.

Figure 1: Impact of Direct and Indirect China Shocks on Establishment-level Employment Growth



(a) Direct Shock **(b)** Indirect Shock

Notes: The bin scatterplots in Figure 1 show the relationship between establishment-level employment growth, $\widetilde{\Delta}\text{Emp}_{(91-07)}$, and either the direct China shock, $\widetilde{\Delta}\text{IP}_{(91-07)}$ (panel (a)), or the indirect China shock, $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) (panel (b)). The direct shock is measured as in Equation (2.1), and the indirect shock is constructed in accordance with Equation (2.5). For all variables, we rely on the Frisch-Waugh theorem and partial out controls used in Table 2 column (3). In each panel, we sort shocks into decile bins and take a weighted average of residualized variables within each bin. In doing so, initial establishment-level employments are used as weights. The linear line and the coefficient are based on the decile points in each panel. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

4 Sectoral Spillovers of China Shock at the Establishment-level

This section provides our main result: Establishment-level employment responds strongly not only to the direct exposure to China shock, but also to the indirect China shock that arises from within-firm sectoral networks.

4.1 Main Result

Graphical Interpretation We start by visualizing the relation between establishment-level employment growth and import competition from China. According to Figure 1, there is a clear negative link in both direct and indirect shocks. Importantly, we observe a much steeper slope between employment growth and the indirect shock (panel (b)) than in the direct shock in panel (a). This suggests that establishment employment is more sensitive to trade exposure that arises from within-firm sectoral networks.

Table 2: Impact of Direct and Indirect China Shocks on Employment Growth: OLS Regressions

	(1)	(2)	(3)	(4)
	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.072***	-0.072***	-0.067***	
	(0.01)	(0.011)	(0.009)	
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)		-0.166***	-0.164***	-0.107***
		(0.035)	(0.033)	(0.032)
N	573,000	573,000	573,000	573,000
R-sq	0.092	0.094	0.144	0.192
Controls	✓	✓	✓	✓
County FE	-	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit

Table 3: Impact of Direct and Indirect China Shocks on Employment Growth: IV Regressions

	(1)	(2)	(3)	(4)
	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.108***	-0.106***	-0.102***	
	(0.012)	(0.013)	(0.012)	
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)		-0.208***	-0.206***	-0.131***
		(0.035)	(0.033)	(0.03)
N	573,000	573,000	573,000	573,000
IV	✓	✓	✓	✓
F stat (direct)	515.6	520.2	603.6	-
F stat (indirect)	-	665.6	768.7	802.6
Controls	✓	✓	✓	✓
County FE	-	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the establishment-level employment growth defined in (2.7), $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). Controls include manufacturing employment share, quadratic polynomials in establishment and firm age, log of initial establishment employment, log of initial firm employment, log of initial within-firm sectoral employment, and log of average initial employment in other establishments within a firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm levels. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers are rounded.

Regression Analysis We now formally estimate Equation (2.8) using OLS on our baseline sample. Column (1) in Table 2 shows that an increase in import competition from China significantly reduces establishment-level employment in directly affected industries. In column (2), we add the within-firm indirect China shock and find that an increase in import competition from China in the firm's other sectors leads to a significant reduction in the establishment's employment growth. Both direct and indirect effects are found to be economically and statistically significant at the 1% level.

However, the impact of the indirect shock on employment growth is an order of magnitude stronger than in the direct effect. Based on the estimates from column (2), we find that the effect of an interdecile increase in the indirect shock is *12 times larger* than that of the direct shock.[18] These results indicate that not taking the indirect shock into account can vastly underestimate the effect that rising import competition from China has on multisector firms.

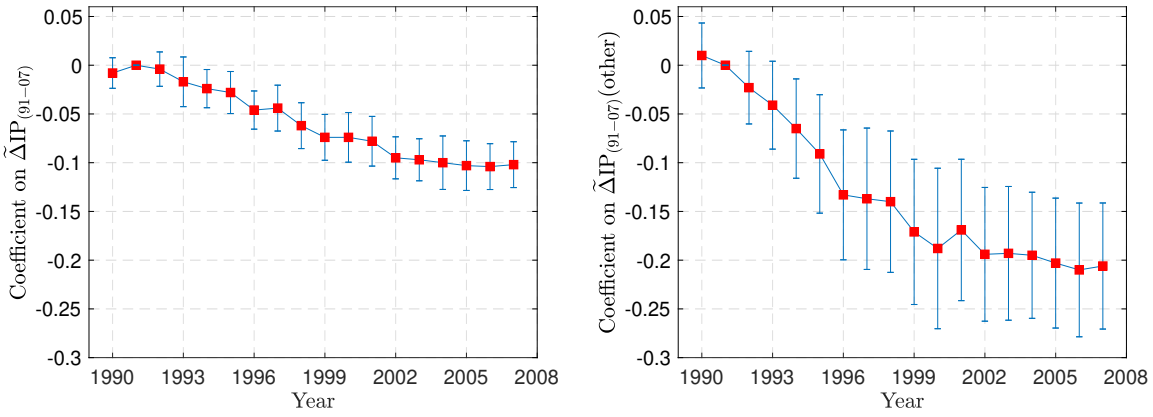
One potential concern in identifying the effect of China shock on the establishment-level employment can emerge when particular industries tend to cluster in nearby regions. In this case, the effect of China shock we aim to identify might arise from comparing establishments located in different regions that are experiencing differential regional shocks (e.g., shifts in local productivity, house price changes, etc.). To account for such confounding effects, we saturate the model with county fixed effects in column (3), thereby absorbing any common variation across establishments within a county. We find that our results barely change.

Our baseline regression includes SIC 2-digit industry fixed effects, which absorb any sectoral shocks at that level. In column (4), we include sector fixed effects at a more disaggregated SIC 4-digit level. Since the direct China shock is constructed for SIC 4-digit industries, by including such fixed effects we absorb the direct effect of China shock. We still find the impact of the indirect China shock to be economically and statistically significant.

Table 3 repeats the analysis in Table 2 by instrumenting $\widetilde{\Delta}\text{IP}_{(91-07)}$ and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) with $\widetilde{\Delta}\text{IPO}_{(91-07)}$ and $\widetilde{\Delta}\text{IPO}_{(91-07)}$ (other), respectively. Consistent with the previous literature, we find that both direct and indirect shocks have a stronger impact on establishment-level

[18] An interdecile increase in the direct shock is associated with a 0.011 ($= -0.072 \times 0.150$) reduction in the employment arc-growth rate. An interdecile increase in the indirect shock leads to a 0.126 ($= -0.166 \times 0.759$) decrease in the arc-growth rate.

Figure 2: Impact of Direct and Indirect China Shocks on Establishment-level Employment Growth since 1991



(a) Direct Shock **(b)** Indirect Shock

Notes: Each panel in Figure 2 plots regression coefficients and 95% confidence intervals obtained from 17 regressions that relate the establishment-level employment growth to 1991-2007 direct and indirect China shocks. The outcome variable in both panels is the employment growth between 1991 and the year indicated on the x-axis. Coefficients for years prior to 1991 refer to employment growth between the year indicated on the x-axis and 1991. All regressions include the vector of control variables from column (3) of Table 3. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

employment growth.

Dynamics To provide a dynamic view of the findings reported above, we follow Autor et al. (2014) and plot the estimated effect of import exposure on the plant-level employment growth calculated on a rolling annual basis for each year from 1991 to 2007. The estimating equation that underlies the figures is identical to our baseline regression (Table 3, column (3)) except that, instead of an establishments' growth over the entire period 1991-2007, we use the growth through the year indicated on the horizontal axis. Both direct and indirect China shocks correspond to the 1991-2007 period, such that the figures depict how the impact of trade competition exposure amasses over time.

Figure 2 reveals a significant adverse effect of import competition on establishment-level employment growth in every year between 1992 and 2007. The impact coefficients become progressively more negative during the 1990s and then stabilize after 2001; the 2001-2007 total decrease is much smaller than the 1992-2001 decrease. It should be emphasized that

this finding, although broadly consistent with the existing literature, might appear to be at odds with the fact that aggregate U.S. manufacturing employment saw a much faster decline after China joined the WTO in 2001. Several factors could account for these differences. First and foremost, the swift decline in manufacturing employment after 2001 was driven by an unprecedented decline in uncertainty (Pierce and Schott, 2016), which is related to and yet very different from the rising import penetration from China. Second, our analysis is focused on multisector firms. Even though such firms are large, they do not fully account for overall manufacturing employment. The stronger impact of indirect China shock on employment dynamics during the 1990s also finds support in the subperiod analysis described in Section 4.2.

4.2 Robustness

To corroborate our main finding, in this section we perform a number of robustness checks.

Placebo Tests: Pretrend Analysis and Placebo Networks One concern in our analysis regards the selection of firms and establishments. That is, an establishment more affected by within-firm sectoral spillover could have been experiencing a declining trend in its employment prior to 1991. We address this concern by conducting a pretrend test. In particular, we follow Autor et al. (2014) and study the relationship between the indirect China shock and the establishment's employment growth between 1976 and 1990. Column (1) of Table A.2 in Appendix A.2 shows no evidence of any pretrend.

What is important for within-firm sectoral spillover is that establishments are connected not to other sectors in general but to other sectors in which the firm is operating. To illustrate this, we follow Giroud and Mueller (2019) and perform a Placebo test by constructing counterfactual random within-firm sectoral networks. Specifically, for each establishment we replace the sector affiliations of all other establishments within a given firm with randomly drawn sectors. We then estimate our main regression equation (2.8) and record coefficient estimates along with standard errors. Column (2) of Table A.2 reports the averaged across 500 repetitions results: Placebo within-firm indirect shocks from other sectors have no significant

effect on establishment-level employment growth.

Correlation between Direct and Indirect Shocks If a firm operates in industries that experience quantitatively similar exposures to import competition from China, then a negative coefficient on the indirect shock we reported earlier might reflect the impact of a common clustered sectoral shock that simulataneously affects all industries in which the firm operates. If this is the case, we should find a positive correlation between direct and indirect China shocks. We, therefore, regress the direct China shock (and also its IV) on the indirect China shock (as well as its corresponding IV). Table A.3 in Appendix A.2 shows no evidence of a statistically significant relation between the two shocks (and their corresponding IVs). Thus, our results cannot be accounted for by shocks that affect multiple industries simultaneously within a firm.

Disaggregated Sector Fixed Effects Provided that our most conservative specification includes sector fixed effects at the SIC 4-digit level, the impact of the indirect China shock is identified by comparing plausibly similar establishments that operate in the same SIC 4-digit industry. However, even within the same SIC 4-digit industry, there is a substantial heterogeneity with respect to the type of output produced.[19] For example, an establishment's supplier and customer composition depends on the product, thereby giving rise to potentially very different employment growth profiles across plants within SIC 4-digit industries.

To assuage this concern, we draw on an alternative dataset, the National Establishment Timeseries Database (NETS), which provides plant-level industry classification at the SIC 8-digit level. By including these disaggregated fixed effects, we absorb not only the establishment's direct exposure to Chinese import competition, but also other indirect effects—such as input-output network propagation and general equilibrium adjustments—that are common across plants within a detailed SIC 8-digit industry. Table A.4 in Appendix A.2 demonstrates that our results hold when we include more detailed industry fixed effects. This implies that the effect of the indirect China shock on establishment-level employment is not driven by disaggregated

[19]For example, SIC 4-digit sector 3711 ("Motor Vehicles & Passenger Car Bodies") includes the following SIC 8-digit industries: 37110201 ("Motor Trucks"), 37110202 ("Truck Tractors For Highway Use"), and 37110403 ("Fire Department Vehicles (Motor Vehicles)").

sectoral components.[20]

Controlling for Other-Sector Characteristics Within-Firm It is also possible that our indirect propagation effect is confounded by other industrial characteristics rather than by China shock that originates from other sectors within the firm. For example, an establishment of a firm in one sector could experience a larger decline in employment not because of its indirect exposure to China shock per se but because the firm experienced an increasing labor productivity in other sectors and, thus, decided to reallocate workers to those industries. To address this concern, we control for various other-sector characteristics (the logarithm of average wages as well as the growth in wages and employment shares between 1976 and 1991), which are constructed analogously to the indirect China shock. Table A.5 in Appendix A.2 demonstrates that the estimates remain stable and highly significant.

Shift-share Robust Standard Errors A growing body of literature has recognized the importance of accounting for correlated errors in case of shocks with a shift-share structure (Adao et al., 2019; Borusyak et al., 2021). Provided that we two-way cluster standard errors by state and firm, our framework is not directly nested by the class of empirical models studied in the aforementioned papers. Nevertheless, we estimate standard errors following Adao et al. (2019) and report the results in Table A.6 in Appendix A.2. We find that the estimates remain highly significant: In fact, the correction leads to even *smaller* standard errors.

Robustness to Outliers and Firm Affiliation/Industry Switchers We now check whether our results are robust to outliers (Table A.7) and firm affiliation/industry switchers (Table A.8). Columns (1) and (2) in Table A.7 in Appendix A.2 exclude the bottom and top 10% of firms by size, respectively. Note that the number of observations drops substantially when the largest enterprises are excluded: This occurs because these enterprises tend to consist of a large number of plants. Columns (3) and (4) exclude establishments at the bottom and top deciles of the indirect China shock distribution. Table A.8 re-estimates our baseline

[20] We also check that our baseline results using SIC 2- and 4-digit industry FE hold in the NETS data.

specification when we drop establishments that experienced a change in firm affiliation or switched an industry. In all cases, our result holds.

Dropping Industries Exposed to Demand Shocks The usage of the instrument introduced in Section 2 rests on the identifying assumption that import demand shocks are not highly correlated between the U.S. and eight developed countries used to construct the instrument.

Following Autor et al. (2013), we check whether our result holds when we exclude industries that are relatively more susceptible to demand shocks that come from the U.S. and other high-income countries. In particular, we omit computer (SIC 1987 industries include 3571, 3572, 3577), construction (3211, 3241, 3312, 3315, 3462, 3493) and apparel ($\in [2211, 2299]$) industries. Table A.9 demonstrates that in all cases the economic and statistical significance of our results is preserved.

Constructing Weights Using only Manufacturing Employment Our baseline definition of the indirect shock $\widetilde{\Delta}IP^{f}_{91-07}(\text{other})$ assumes zero exposure of non-manufacturing plants to Chinese import competition ($\widetilde{\Delta}IP^{b,f}_{j,91-07} = 0$). This should not pose a serious problem because throughout the analysis, we control for *(i)* the firm-level share of the manufacturing employment and *(ii)* the employment share of other establishments within a firm.

Nevertheless, in Table A.10 we experiment with an *alternative* definition of the indirect shock, in which the denominator of the weight does not include non-manufacturing employment. In this case, the weight in Equation (2.5) takes the following form:

$$\omega^{f}_{j',-j,91} \equiv \frac{Emp^{f}_{j',91}}{\sum_{(j''\neq j)\&(j''\in \mathbf{Mfg})} Emp^{f}_{j'',91}}. \tag{4.1}$$

We obtain robust results.

Additional Results We conclude this section by mentioning additional results. In addition to the baseline 16-year period 1991-2007, we consider *subperiods* 1991-1999 and 1999-2007 in Tables A.11 and A.12, respectively. In line with Figure 2, the results indicate that the impact of the indirect shock was much stronger prior to 1999. We also consider an *unweighted* regression

in Table A.13 and find that our results are not driven by large establishments.

4.3 Spillover Effects Within and Outside the Manufacturing Sector

According to our main result, the trade shock spills across sectors through within-firm sectoral networks. However, an open question is whether the shock propagates mainly within the manufacturing sector or whether it also affects establishments that operate in the non-manufacturing sector. In other words, the effect we have documented can mask substantial heterogeneity in responsiveness to Chinese import competition across sectors. To further examine this issue, we consider manufacturing and non-manufacturing establishments separately and investigate whether our results hold in each subsample.[21] As noted in a more detailed discussion below, we find that within-firm sectoral spillovers occur both from manufacturing to non-manufacturing industries and across manufacturing industries in the same firm.

Spillovers within the Manufacturing Sector In Table 4, we repeat the analysis presented in Table 3 by restricting our sample to manufacturing establishments. We find that a manufacturing plant reduces employment in response to indirect China shock that arises from establishments in other manufacturing industries within the firm as well as to China shock that affects the establishment's industry directly. In particular, we find that the coefficient is -0.10 on the direct effect and -0.18 on the indirect one. This is only marginally lower than the coefficient of the baseline sample. Both effects are significant at the 1% level in the tightest specification considered (column (3)). We also find a quantitatively similar result when we saturate the model with SIC 4-digit industry fixed effects, thereby absorbing the direct exposure (column (4)).

Spillovers from Manufacturing to Non-Manufacturing Establishments Table 5 reports the results when we restrict the sample to non-manufacturing establishments. Provided that the direct China shock is defined only for manufacturing industries, we do not estimate the direct effect in this case.

[21] The shocks are constructed using the baseline sample, including all establishments owned by multisector firms that operate at least one manufacturing establishment.

Table 4: Impact of Direct and Indirect China Shocks on Employment Growth: Manufacturing Establishments

	(1)	(2)	(3)	(4)
	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.101***	-0.101***	-0.098***	
	(0.013)	(0.013)	(0.013)	
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)		-0.190***	-0.182***	-0.130***
		(0.036)	(0.033)	(0.034)
N	121,000	121,000	121,000	121,000
IV	✓	✓	✓	✓
F stat (direct)	474.8	476.8	559.1	-
F stat (indirect)	-	409.9	560.2	507.1
Controls	✓	✓	✓	✓
County FE	-	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit

Table 5: Regression with Disaggregate Sector Fixed Effects: Non-Manufacturing Establishments

	(1)	(2)	(3)
	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.244***	-0.245***	-0.135**
	(0.062)	(0.061)	(0.058)
N	452,000	452,000	452,000
IV	✓	✓	✓
First-stage F stat	394.2	411.5	435.4
Controls	✓	✓	✓
County FE	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 4-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the establishment-level employment growth defined in (2.7), $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). Controls include manufacturing employment share, establishment age and age-squared, firm age and age-squared, log of initial establishment employment, log of initial firm employment, log of initial sector employment within firm, and log of average initial employment in other establishments within firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table 6: Extensive versus Intensive Margin of Employment Adjustments

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$			$\widetilde{\Delta}\text{Emp}_{(91-07)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Margin	Overall	Extensive	Intensive	Overall	Extensive	Intensive
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.102***	-0.123***	0.021**			
	(0.012)	(0.016)	(0.008)			
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.206***	-0.209***	0.003	-0.131***	-0.145***	0.014
	(0.033)	(0.037)	(0.017)	(0.03)	(0.037)	(0.018)
N	573,000	573,000	573,000	573,000	573,000	573,000
IV	✓	✓	✓	✓	✓	✓
F stat (direct)	603.6	603.6	603.6	-	-	-
F stat (indirect)	768.7	768.7	768.7	802.6	802.6	802.6
Controls	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Overall) is the establishment-level employment growth defined in (2.7). $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Extensive) indicates employment growth from establishment closures, and $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Intensive) indicates employment growth from continuing establishments. $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). Controls include manufacturing employment share, establishment age and age-squared, firm age and age-squared, log of initial establishment employment, log of initial firm employment, log of initial sector employment within firm, and log of average initial employment in other establishments within firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

We find that the within-firm indirect China shock has an economically and statistically significant impact on employment in non-manufacturing plants: The coefficient on the indirect effect is bound between -0.25 and -0.14, which is similar in magnitude to the coefficient in the case of the manufacturing sector. This implies that within-firm sectoral networks propagate China shock nearly uniformly to both manufacturing and non-manufacturing establishments. Remarkably, this result is not driven by general equilibrium adjustments within regions (e.g., a within-region general equilibrium effect from manufacturing to non-manufacturing sectors), and we know this because we include both county and industry fixed effects.

4.4 Extensive and Intensive Margins Decomposition

This section decomposes the growth in employment into two margins. Along the intensive margin, multisector firms can choose to adjust employment in continuing plants. Along the extensive margin, firms can decide to close some establishments. Recent work by Asquith et al. (2019) demonstrates that the direct China shock affected U.S. employment mainly through establishment exit. In this section, we investigate how firms adjust to China shock that arises through within-firm networks: Firms can undo intensive margin adjustments with relative ease once the business environment changes favorably, but extensive margin adjustments are more permanent.[22] Thus, understanding the way firms respond to indirect China shock can shed light on how persistent the impact of that shock was on the U.S. private business sector.

To address this issue, we first decompose the establishment-level employment growth into two margins, and then we separately re-estimate our main specification (2.8) for each margin. Provided that the arc-growth measure (2.7) used in this paper allows for the unified treatment of continuing and exiting establishments, the decomposition of the plant-level growth into two margins is straightforward.

Table 6 reports the result. In line with Asquith et al. (2019), we find that the direct shock mainly propagates through the extensive margin. Importantly, the data reveal that the indirect shock also operates through the extensive margin. The result holds regardless of whether the direct shock is controlled for (Columns 1-3) or absorbed (Columns 4-6). This implies that the economic, social, and political consequences of the rising import competition from China documented in the recent literature could be even larger because of the within-firm propagation channel.

One concern associated with this decomposition is the absence of the entry margin, the importance of which has been highlighted in many different contexts, including literature on import competition (Magyari, 2017).[23] To address this concern, we augment our baseline

[22] Establishment exit can lead to many adverse consequences, including higher worker mortality and income inequality (see Herzog Jr. and Schlottmann, 1995, Hu and Taber, 2011, Pierce and Schott, 2020, among many others).

[23] Several recent papers show the importance of the entry margin for the propagation of aggregate shocks (e.g., Clementi and Palazzo, 2016; Smirnyagin, 2021) and for long-term local economic growth (Walsh, 2019).

sample with a set of plants that entered after 1991 and reported positive employment in 2007. Note that all additional establishments belong to firms from the original sample. Subsequently, we follow Davis et al. (1996) and assign the employment growth rate of 2 to plants that entered after 1991, and we separately re-estimate Equation (2.8) for all three margins (intensive, exit and entry). Furthermore, to accommodate plants that did not exist in 1991, we weight observations by the mid-point employment. Table A.14 in Appendix demonstrates that the exit margin remains highly significant and it accounts for the overall effect. The entry margin in our sample is quantitatively small and statistically insignificant.

4.5 Mechanisms: Heterogeneous Treatment Effects

To explore mechanisms of within-firm China shock propagation, this section studies various heterogeneous treatment effects. In particular, we examine how the impact of the indirect China shock depends on different firm- and establishment-level characteristics. The results of this section are summarized in Table 7, in which Z_f denotes the characteristic of interest.

Within-firm Trade We first study how input-output linkages between establishments *within* a firm affect the magnitude of the indirect effect. Because cross-establishment trade information is not available to us, we rely on industry-level input-output tables to assess the role of within-firm trade.[24]

Specifically, we construct a dummy ("Use= 1") that takes a value of 1 if the industry of a given establishment *uses inputs from* industries of other establishments within the same firm. In doing so, we strike a balance between the measurement error associated with the lack of the cross-establishment trade data and the identification of cases when the plant is unlikely to use any inputs from other establishments within the same firm. Similarly, we construct a dummy ("Supply= 1") that takes a value of 1 if an industry of the establishment *supplies inputs to* industries of other establishments within the same firm.

Column (1) indicates that the usage of inputs from other establishments within the firm exacerbates the impact of the indirect effect. This result is consistent with the idea

[24]The "use" and "supply" input-output tables we use are provided by the BEA.

Table 7: Heterogeneous Treatment Effects

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$					
	Within-firm Trade		Scope		Size	
	(1)	(2)	(3)	(4)	(5)	(6)
Z_f is	Use=1	Supply=1	Num. Sectors	1-HHI	Estab. Size	Firm Size
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) $\times$ Z_f	-0.090**	0.027	0.204**	0.325**	-0.034**	-0.017
	(0.045)	(0.071)	(0.089)	(0.161)	(0.015)	(0.014)
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.049	-0.137**	0.179	-0.063	0.044	0.003
	(0.041)	(0.056)	(0.134)	(0.091)	(0.071)	(0.098)
Z_f	0.03	-0.048	-0.122**	-0.199*	0.048***	-0.055***
	(0.03)	(0.062)	(0.059)	(0.103)	(0.009)	(0.008)
N	573,000	573,000	573,000	573,000	573,000	573,000
IV	✓	✓	✓	✓	✓	✓
F stat (indirect x Z_f)	3575	5329	927	1030	545.8	1473
Controls	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the establishment-level employment growth defined in (2.7). $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). In column (1) (or (2)), Z_f stands for the dummy taking 1 if the industry of the establishment uses inputs from (supplies inputs to) any other manufacturing industries of other establishments in the same firm. In column (3), Z_f represents the number of SIC-4 digit sectors in the firm to which the establishment belongs. In column (4), Z_f is the 1 minus HHI of the firm. In columns (5) and (6), Z_f denotes the log of initial employment of the establishment and the firm, respectively. Controls include the manufacturing employment share, establishment age and age-squared, firm age and age-squared, log of initial establishment employment, log of initial firm employment, log of initial sector employment within the firm, and log of average initial employment in other establishments within the firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

that downstream industries tend to lose relation-specific production in the aftermath of trade shocks that hit the industries from which they receive inputs.[25] In contrast, according to column (2), we find no empirical evidence that upstream linkages across plants within firms play a pronounced role; indeed, there is no statistically significant difference in employment

[25]This is a hypothesis put forward by Acemoglu et al. (2016a) based on their industry-level analysis. According to Acemoglu et al. (2016a), China shock reduces the cost of inputs (positive effect), on the one hand, and it leads to a loss of relation-specific production (negative effect), on the other hand. In the case of multisector firms, the negative effect likely dominates the positive one, thereby rationalizing our result.

response to the indirect China shock between plants that do and do not supply inputs to other establishments within a firm.[26]

Economies of Scope A growing body of literature emphasizes how economies of scope affect the ability of firms to adjust to shocks (Argente et al., 2020; Ding et al., 2020). We hypothesize that firms with a wider scope of operation may more easily shield themselves against the rising import competition from China propagated through within-firm networks.

To evaluate this hypothesis, we utilize two metrics of each firm's scope: the number of distinct SIC 4-digit industries in which the firm operates (column (3)); and the Herfindahl-Hirschman Index (column (4)).[27] The HHI measures how concentrated the firm-level employment is across SIC 4-digit industries. To make both measures increase in scope, we subtract the HHI-based metric from 1. In both cases, the interaction term is statistically significant at 5%, suggesting that firms with a wider scope more easily accommodate the China shock propagated through within-firm networks.

Establishment and Firm Size Several recent papers have documented a stronger response of larger plants to *direct* China shock (Park, 2020; Argente et al., 2020). Holmes and Stevens (2014) argue that this occurs because large establishments—which tend to produce standardized goods—are more likely to face fierce competition from China, which in the early phase of its development mainly exported standardized goods.

Columns (5) shows that large plants do, indeed, reduce their employment more strongly in response to the indirect China shock, consistent with the logic of the aforementioned papers. However, a firm's size (column (6)) does not play a significant role. This can reflect the highly diversified nature of multisector firms: While some plants are small and niche-product-oriented, the remaining establishments within a firm can produce standardized goods.

[26] A potential explanation for this is that the customer base of upstream plants might have moved to China and did not simply exit. U.S. multinational firms could also offshore certain industries to China while still providing core inputs to the (offshored) Chinese factories. This occurs when firms engage in forward vertical FDI; here the indirect shock propagation would not be greater for the upstream manufacturers in the same firm.

[27] Provided that a firm's scope is highly correlated with its size (Giroud and Mueller, 2019), in specifications (3) and (4) of Table 7, we also control for the interaction of the indirect shock with the firm size.

Capital and Skill Intensities In response to the increased import competition from China, multisector U.S. firms may choose to switch from labor-intensive to more capital-intensive activities, and they do so because China has a comparable advantage in labor-intensive products due to its cheaper labor force. In this case, we would see a weaker employment response of plants that operate in more capital-intensive industries. Drawing on the NBER-CES Manufacturing Database, we construct a measure of capital intensity and interact it with the indirect shock. Column (1) of Table A.15 shows that the employment response was similar across plants that had different capital intensities.[28] Similarly, U.S. firms may focus on more complex products, leveraging the advantage of having a more skillful labor force. However, this possibility is not supported by the data in Column (2) of Table A.15.

Financial Conditions Financial constraints were shown to play an important role in a firms' ability to adjust to shocks (Giroud and Mueller, 2017 demonstrate this in the context of the within-firm propagation of regional housing price shocks). As noted in our introduction, poor financial conditions can induce firms to shrink employment in establishments not directly affected by the increased import competition from China, and this may account for the indirect propagation channel we have documented.

To evaluate the role played by financial conditions, we draw on Compustat and construct a measure of a firm-level leverage.[29] Subsequently, we merge the Compustat extract into our sample using the Compustat Bridge, thereby restricting the sample to establishments that are part of publicly-traded firms. Although it seems plausible that financial conditions should play a role in propagation of China shock within a firm, Column (3) of Table A.15 shows no support for this view.[30]

[28] Capital intensity is the ratio of capital to total employment, while skill intensity is the ratio of non-production workers to the total number of employees.

[29] The firm leverage is defined as a ratio of total debt (short-term and long-term) to total assets. We experimented with several other metrics of financial constrains, including the Kaplan and Zingales (1997) index, but did not find a significant result.

[30] On top of the specification in which direct and indirect shocks over the entire period 1991-2007 are interacted with the firm-level leverage in 1991, we experimented with a version with annualized direct and indirect China shocks (results for this version are reported in Table A.15). The latter specification reflects the idea that firms can undo financial constraints over a long 16-year baseline time period, calling for a year-to-year analysis. However, in all cases we obtained insignificant results.

5 Sector-Level Spillovers

We have documented that Chinese import competition has an economically and statistically strong impact on establishment-level employment that operates though within-firm sectoral networks. In this section, we move a step forward and investigate whether this indirect China shock survives aggregation to the sector level. That is, we study how sector-level employment responds to China shock that hits other sectors that are linked through within-firm networks.

5.1 Empirical Specification

We start by constructing a measure of indirect exposure to China shock for each sector j: This is the weighted average of shocks that hit other industries $j' \neq j$ and propagate to industry j through within-firm sectoral networks.[31] Formally, the measure is constructed as

$$\widetilde{\Delta} IP_{j,91-07} \text{ (other)} = \sum_{j' \neq j} \lambda_{j',-j,91} \times \widetilde{\Delta} IP_{j',91-07}, \tag{5.1}$$

where $\lambda_{j',-j,t}$ is a weight assigned to industry $j' \neq j$ and $\widetilde{\Delta} IP_{j',91-07}$ is an import penetration measure for industry j' defined as in Equation (2.1). On the conceptual level, the construction of the sector-level shock is similar to that of the establishment-level indirect shock in Equation (2.5).

We define sector j' weight $\lambda_{j',-j,t}$ as follows:

$$\lambda_{j',-j,t} \equiv \sum_{f} \frac{Emp^{f}_{j,t}}{\sum_{f'} Emp^{f'}_{j,t}} \times \omega^{f}_{j',-j,t}, \tag{5.2}$$

where the term $\omega^{f}_{j',-j,t}$ is the same as in Equation (2.5):

$$\omega^{f}_{j',-j,t} \equiv \frac{Emp^{f}_{j',t}}{\sum_{j'' \neq j} Emp^{f}_{j'',t}}.$$

Therefore, the weight $\lambda_{j',-j,t}$ is constructed by averaging firm-level employment shares in sector

[31] Our approach is reminiscent of that assumed by Giroud and Mueller (2019).

j' for each firm f (term $\omega^f_{j',-j,t}$) according to the relative employment size of firms in sector j. Intuitively, we first measure how "important" sector j' is for each firm, and then average that across firms with respect to their presence in sector j. Thus, one can interpret $\lambda_{j',-j,t}$ as the extent to which industry j is exposed to industry j' through within-firm sectoral networks created by multisector firms.

Guided by the same considerations as before, we instrument $\widetilde{\Delta}IP_{j,91-07}$ (other) by the indirect shock based on the exposure of other high income countries to the import competition from China:

$$\widetilde{\Delta}IPO_{j,91-07}\text{ (other)} = \sum_{j' \neq j} \lambda_{j',-j,91} \times \widetilde{\Delta}IPO_{j',91-07}. \tag{5.3}$$

Our baseline industry-level specification takes the following form:

$$\widetilde{\Delta}Emp_{j,91-07} = \beta_0 + \beta_1 \widetilde{\Delta}IP_{j,91-07} + \beta_2 \widetilde{\Delta}IP_{j,91-07}\text{ (other)} + \beta_3 Z'_{j,0} + \delta_j + \varepsilon_{j,91-07}, \tag{5.4}$$

where $\widetilde{\Delta}Emp_{j,91-07}$ is the arc-growth in sector j's employment between 1991 and 2007. The vector of sector-level controls $Z_{j,0}$ includes the logarithm of initial employment as well as the share of the industry-level employment accounted for by our sample. δ_j indicates sector fixed effects at the SIC 2-digit level. Observations are weighted by initial employment.

5.2 Sector-Level Results

We estimate Equation (5.4) for all industries as well as for the manufacturing sector separately. Our results are the strongest when we focus on manufacturing industries, whereas the estimates are less precisely estimated in case the non-manufacturing sector is included: This reflects the fact that multisector firms in our sample account for three-quarters of the manufacturing employment but for only about 20% of the overall employment. In what follows, the results for the manufacturing sector are described. The results for all sectors are reserved for the Appendix (see Table A.16).

Table 8 reports our findings. Column (1) only includes direct China shock and demonstrates that our results are consistent with the existing literature that documents the adverse impact

Table 8: Sectoral Aggregate Impact of Direct and Indirect China Shocks on Manufacturing Employment Growth

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$				
Margin	Overall	Overall	Exit	Intensive	Entry
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.098**	-0.090**	-0.028**	-0.021	-0.042
	(0.042)	(0.041)	(0.014)	(0.017)	(0.031)
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)		-0.747*	-0.371***	0.078	-0.454
		(0.444)	(0.12)	(0.177)	(0.327)
N	400	400	400	400	400
IV	✓	✓	✓	✓	✓
F stat (direct)	41.9	45	45	45	45
F stat (indirect)	-	228.9	228.9	228.9	228.9
Controls	✓	✓	✓	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 2-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Overall) is the sector-level employment growth. $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Exit) indicates sector-level employment growth from establishment closures, $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Intensive) indicates sector-level employment growth from continuing establishments, and $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Entry) indicates sector-level employment growth from establishment entry. $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (5.1). Controls include the logarithm of initial employment and the share of the industry-level employment accounted for the baseline sample described in Section 3.2. All regressions are weighted by initial sector-level employment. Standard errors are clustered at the SIC 2-digit level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

of rising import competition from China on U.S. employment. Furthermore, column (2) adds the indirect sector-level China shock and shows that it is large in magnitude and statistically significant at the 10% level. This finding implies that within-firm networks are quantitatively important for the propagation of shocks not only across establishments within the firm but also across sectors of the aggregate economy.

Columns (3), (4) and (5) decompose the growth in the sector-level employment into exit, intensive and entry margins, respectively. The data reveal that, similar to the establishment-level decomposition analysis in Section 4.4, the exit margin is large in magnitude and is statistically significant at the 1% level. Thus, the establishment-level results reported above carry over to the sector-level.[32]

[32]Table A.16 in Appendix A.5 shows that the importance of the exit margin is preserved even if we consider

6 Conclusion

We document a novel channel through which trade shocks propagate across industries: In particular, we study U.S. multisector firms and find that employment of an establishment in a given industry is negatively affected by China shock that hits establishments in other industries within the same firm. This finding highlights the important role firms' internal networks play in the propagation of sectoral shocks. Moreover, we document that such spillovers are not muted at the sectoral aggregate level, implying that within-firm internal networks can induce industry-level employment adjustments.

We see several fruitful avenues for future research. First, what is the quantitative importance of the within-firm sectoral propagation channel as compared with other previously documented channels, including supply chain spillovers, financial networks, migration, and local market adjustments? Answering this important question calls for a fully-fledged model with various linkages, which is beyond the scope of this paper. Moreover, the design of optimal trade and industry-level policies in the presence of within-firm sectoral linkages remains to be an open question. We leave these issues to future research.

both manufacturing and non-manufacturing sectors.

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A Additional Tables

A.1 Summary Statistics at the Sector-level

Table A.1: Summary Statistics: Sector-level

Overall						
Variable	Obs.	Mean	Std. Dev.	P10	P50	P90
$\widetilde{\Delta}\text{Emp}_{(91-07)}$	850	0.198	0.749	-0.645	0.111	1.261
$\widetilde{\Delta}\text{IP}_{(91-07)}$	850	0.313	0.936	0	0	0.892
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	850	0.247	0.175	0.057	0.215	0.490
Emp 1991 (thousand)	850	112.2	369.9	6.2	33.8	208.3
Manufacturing						
Variable	Obs.	Mean	Std. Dev.	P10	P50	P90
$\widetilde{\Delta}\text{Emp}_{(91-07)}$	400	-0.135	0.589	-0.861	-0.175	0.618
$\widetilde{\Delta}\text{IP}_{(91-07)}$	400	0.688	1.293	0.002	0.225	1.960
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	400	0.288	0.181	0.072	0.251	0.528
Emp 1991 (thousand)	400	43.8	64.9	6.3	21.8	97.2
Non-Manufacturing						
Variable	Obs.	Mean	Std. Dev.	P10	P50	P90
$\widetilde{\Delta}\text{Emp}_{(91-07)}$	450	0.471	0.757	-0.407	0.409	1.512
$\widetilde{\Delta}\text{IP}_{(91-07)}$	450	0	0	0	0	0
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	450	0.213	0.162	0.052	0.174	0.415
Emp 1991 (thousand)	450	168.6	489.2	6.2	56.9	339.4

Notes: This table provides sector-level summary statistics for the sample in Section 5. These summary statistics are calculated by including all establishments within each sector—i.e., they include both multisector and single-sector firms. The data come from the Census Longitudinal Business Database (LBD). $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the sector-level employment growth, $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock, and $\widetilde{\Delta}\text{IP}_{(91-07)}$(other) is the indirect China shock from other sectors through within-firm linkages. A detailed description of variables can be found in Section 2. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

A.2 Robustness

Table A.2: Placebo Tests: Pretrend Check and Placebo Networks

	(1)	(2)
	Pretrend Check	Placebo Networks
	$\widetilde{\Delta}\text{Emp}_{(76-90)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.013	
	(0.024)	
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other, placebo)		-0.001
		(0.028)
N	157,000	573,000
IV	✓	✓
First-stage F stat	664.6	1355
Controls	✓	✓
County FE	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit

Notes: This table uses the same specification as in column (4) in Table 3, where (i) column (1) – pretrend check – replaces the dependent variable with the establishment-level employment growth between 1976 to 1990, $\widetilde{\Delta}\text{Emp}_{(76-90)}$, and (ii) column (2) – Placebo networks – replaces the indirect China shock with the Placebo indirect China shock constructed from random within-firm sectoral networks, $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other, placebo). All numbers in column (2) are the average of 500 draws of random within-firm sectoral networks and the associated regressions. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.3: Relation between Direct and Indirect Shocks

	(1) $\widetilde{\Delta}\text{IP}_{(91-07)}$	(2) $\widetilde{\Delta}\text{IP}_{(91-07)}$	(3) $\widetilde{\Delta}\text{IPO}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.012		
	(0.019)		
$\widetilde{\Delta}\text{IPO}_{(91-07)}$ (other)		0.006	0.012
		(0.016)	(0.011)
N	573,000	573,000	573000
R-sq	0.499	0.499	0.494
Controls	✓	✓	✓
County FE	✓	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit

Notes: $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), $\widetilde{\Delta}\text{IPO}_{(91-07)}$ is the IV for direct China shock defined in (2.4), $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5), and $\widetilde{\Delta}\text{IPO}_{(91-07)}$ (other) is the IV for indirect China shock defined in (2.6). Controls include manufacturing employment share, establishment age and age-squared, firm age and age-squared, log of initial establishment employment, log of initial firm employment, log of initial sector employment within a firm, and log of average initial employment in other establishments within firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.4: Regression with Disaggregate Sector Fixed Effects

	(1)	(2)
	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.065***	-0.063***
	(0.019)	(0.020)
R^2	0.008	0.008
IV	✓	✓
First-stage F stat	322.3	268.3
Controls	✓	✓
County FE	✓	✓
Industry FE	SIC 6-digit	SIC 8-digit
Observations	290028	287493

Notes: This table uses the data from the National Establishment Timeseries Database (NETS). $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the establishment-level employment growth defined in (2.7), $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). Controls include manufacturing employment share, firm age and age-squared, log of initial establishment employment, log of initial firm employment, and log of initial firm sales. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Table A.5: Controlling for Other-Sector Characteristics Within-Firm

	(1) $\widetilde{\Delta}\text{Emp}_{(91-07)}$	(2) $\widetilde{\Delta}\text{Emp}_{(91-07)}$	(3) $\widetilde{\Delta}\text{Emp}_{(91-07)}$	(4) $\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.131***	-0.143***	-0.136***	-0.132***
	(0.03)	(0.033)	(0.031)	(0.034)
Growth in emp. share 1976-1991 (other)	0.23			0.491
	(2.337)			(2.272)
Log wage 1991 (other)		-0.042*		0.013
		(0.022)		(0.027)
Growth in log wage 1976-1991 (other)			-0.127***	-0.142***
			(0.037)	(0.045)
N	573,000	573,000	573,000	573,000
IV	✓	✓	✓	✓
First-stage F stat	794.1	783.7	799	766.2
Controls	✓	✓	✓	✓
County FE	✓	✓	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: This table uses the same specification as in column (4) in Table 3, where we additionally control for characteristics of other sectors within a firm. These other-sector characteristics include growth in the sectoral employment share between 1976-1991, log of sector-level wage, and growth in log wage between 1976-1991. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.6: Shift-Share Robust Standard Error following Adao et al. (2019)

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$		
	(1)	(2)	(3)
Sample	All	Mnf	Non-mnf
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.131***	-0.130***	-0.135**
	(0.02)	(0.024)	(0.041)
N	573,000	121,000	452,000
IV	✓	✓	✓
First-stage F stat	802.6	507.1	435.4
Controls	✓	✓	✓
County FE	✓	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: This table uses the same specification as in column (4) in Table 3, where we use a shift-share robust standard error following Adao et al. (2019). *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.7: Dropping Outliers

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$			
	By Firm Size		By Indirect Shock	
	(1)	(2)	(3)	(4)
Exclude	Bottom 10%	Top 10%	Bottom 10%	Top 10%
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.102***	-0.056***	-0.094***	-0.111***
	(0.012)	(0.011)	(0.012)	(0.013)
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.206***	-0.056**	-0.215***	-0.200**
	(0.033)	(0.027)	(0.034)	(0.083)
N	564,000	161,000	516,000	516,000
IV	✓	✓	✓	✓
F stat (direct)	602.9	773	416.8	630.7
F stat (indirect)	766.4	1390	650	1292
Controls	✓	✓	✓	✓
County FE	✓	✓	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 2-digit

Notes: This table uses the same specification as in column (4) in Table 3, where we drop establishments affiliated with firms in the bottom/top 10% by firm size (column (1) and column (2)) or we drop establishments that faced the bottom/top 10% magnitude of indirect China shock (column (3) and column (4)). Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.8: Dropping Establishments with Affiliation or Industry Change

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$			
	(1)	(2)	(3)	(4)
Exclude	Affiliation Change		Industry Change	
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.093***		-0.120***	
	(0.013)		(0.013)	
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.179***	-0.126***	-0.213***	-0.136***
	(0.041)	(0.034)	(0.034)	(0.029)
N	505,000	505,000	530,000	530,000
IV	✓	✓	✓	✓
F stat (direct)	452.7	-	458	-
F stat (indirect)	720	750.5	676	688.2
Controls	✓	✓	✓	✓
County FE	✓	✓	✓	✓
Industry FE	SIC 2-digit	SIC 4-digit	SIC 2-digit	SIC 4-digit

Notes: This table uses the same specifications as those used in column (3) and column (4) in Table 3, where we drop establishments that changed affiliation (column (1) and column (2)) or changed industry (column (3) and column (4)) during the sample period. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.9: Drop Industries Affected by Demand Shocks Hitting High-Income Countries

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$			
	(1)	(2)	(3)	(4)
Dropped industries	No construction	No computer	No apparel	All three
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.137***	-0.136***	-0.129***	-0.139***
	(0.03)	(0.029)	(0.03)	(0.03)
N	572,000	573,000	572,000	571000
IV	✓	✓	✓	✓
First-stage F stat	795.8	804.8	781.6	777.3
Controls	✓	✓	✓	✓
County FE	✓	✓	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: The specification estimated in this table is the same as the one used in the last column of Table 3. Columns (1), (2), and (3) drop construction (SIC 1987 industries include 3211, 3241, 3312, 3315, 3462, 3493), computer (3571, 3572, 3577) and apparel ($\in [2211, 2299]$) industries from the core sample, respectively. Column (4) drops all three industries from the sample. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.10: Alternative Definition of the Indirect Shock

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$		
	(1)	(2)	(3)
Sample	All	Mnf	Non-mnf
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.174***	-0.164***	-0.171**
	(0.039)	(0.044)	(0.079)
N	573,000	121,000	452,000
IV	✓	✓	✓
First-stage F stat	544.6	441.2	373.7
Controls	✓	✓	✓
County FE	✓	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: The underlying equations for columns (1), (2) and (3) in this table are identical to those used in column (4) from Tables 3, 4 and 5, respectively. The difference arises due to an alternative definition of the indirect shock: We only consider manufacturing employment to construct the weight in Equation (2.5):

$$\omega^{f}_{j',-j,91} \equiv \frac{Emp^{f}_{j',91}}{\sum_{(j''\neq j)\&(j''\in \mathbf{Mfg})} Emp^{f}_{j'',91}}.$$

Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.11: Impact of Direct and Indirect China Shocks on Employment Growth: Subperiod 1991-1999

	(1)	(2)	(3)	(4)
	$\widetilde{\Delta}\text{Emp}_{(91-99)}$	$\widetilde{\Delta}\text{Emp}_{(91-99)}$	$\widetilde{\Delta}\text{Emp}_{(91-99)}$	$\widetilde{\Delta}\text{Emp}_{(91-99)}$
$\widetilde{\Delta}\text{IP}_{(91-99)}$	-0.181***	-0.181***	-0.184***	
	(0.025)	(0.026)	(0.026)	
$\widetilde{\Delta}\text{IP}_{(91-99)}$ (other)		-0.469***	-0.497***	-0.270***
		(0.127)	(0.121)	(0.099)
N	573,000	573,000	573,000	573,000
IV	✓	✓	✓	✓
F stat (direct)	218.4	233.8	264.6	-
F stat (indirect)	-	86.2	82.6	75.1
Controls	✓	✓	✓	✓
County FE	-	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit

Table A.12: Impact of Direct and Indirect China Shocks on Employment Growth: Subperiod 1999-2007

	(1)	(2)	(3)	(4)
	$\widetilde{\Delta}\text{Emp}_{(99-07)}$	$\widetilde{\Delta}\text{Emp}_{(99-07)}$	$\widetilde{\Delta}\text{Emp}_{(99-07)}$	$\widetilde{\Delta}\text{Emp}_{(99-07)}$
$\widetilde{\Delta}\text{IP}_{(99-07)}$	-0.045***	-0.043***	-0.040***	
	(0.007)	(0.007)	(0.006)	
$\widetilde{\Delta}\text{IP}_{(99-07)}$ (other)		-0.039***	-0.036***	-0.018**
		(0.01)	(0.01)	(0.009)
N	744,000	744,000	744,000	744,000
IV	✓	✓	✓	✓
F stat (direct)	1902	2118	2330	-
F stat (indirect)	-	2657	2869	3937
Controls	✓	✓	✓	✓
County FE	-	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit

Notes: Column (1) to Column (4) in Table A.11 and Table A.12 use the identical specifications used in column (1) to column (4) in Table 3, respectively, where we consider periods 1991-1999 (Table A.11) and 1999-2007 (Table A.12). Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

Table A.13: Impact of Direct and Indirect China Shocks on Employment Growth: Unweighted Regression

	(1)	(2)	(3)	(4)
	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$	$\widetilde{\Delta}\text{Emp}_{(91-07)}$
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.072***	-0.070***	-0.067***	
	(0.009)	(0.008)	(0.009)	
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)		-0.146***	-0.140***	-0.131***
		(0.047)	(0.048)	(0.04)
N	573,000	573,000	573,000	573,000
IV	✓	✓	✓	✓
F stat (direct)	1242	1381	1440	-
F stat (indirect)	-	288.1	296.2	289
Controls	✓	✓	✓	✓
County FE	-	-	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit

Notes: Column (1) to column (4) in this table use the identical specifications used in column (1) to column (4) in Table 3, respectively, where we consider unweighted regression. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

A.3 Additional Results on Decomposition

Table A.14: Decomposition with Entry Margin

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$				$\widetilde{\Delta}\text{Emp}_{(91-07)}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Margin	Overall	Exit	Intensive	Entry	Overall	Exit	Intensive	Entry
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.071***	-0.065***	-0.007	0.001				
	(0.012)	(0.009)	(0.006)	(0.005)				
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.157***	-0.109***	-0.018	-0.03	-0.144***	-0.094***	-0.015	-0.035
	(0.042)	(0.021)	(0.014)	(0.022)	(0.044)	(0.022)	(0.011)	(0.025)
N	1,073,000	1,073,000	1,073,000	1,073,000	1,073,000	1,073,000	1,073,000	1,073,000
IV	✓	✓	✓	✓	✓	✓	✓	✓
F stat (direct)	1364	1364	1364	1364	-	-	-	-
F stat (indirect)	463.8	463.8	463.8	463.8	343.6	343.6	343.6	343.6
Controls	✓	✓	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Overall) is the establishment-level employment growth defined in (2.7). $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Extensive) indicates employment growth from establishment closures, $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Intensive) indicates employment growth from continuing establishments, and $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Entry) indicates employment growth from newly-entering establishments. $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2), and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). Controls include manufacturing employment share, establishment age and age-squared, firm age and age-squared, log of initial establishment employment, log of initial firm employment, log of initial sector employment within firm, and log of average initial employment in other establishments within the firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

A.4 Additional Results on Heterogeneous Treatment Effects

Table A.15: Heterogeneous Treatment Effects: Intensity and Financial Constraint

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$		
	Intensity		Financial Constraint
	(1)	(2)	(3)
Z_f is	Capital Intensity	Skill Intensity	Firm Leverage
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) $\times$ Z_f	-0.027	-0.014	-0.037
	(0.033)	(0.032)	(0.079)
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)	-0.173***	-0.161***	-0.004
	(0.036)	(0.034)	(0.024)
Z_f	0.01	-0.048	-0.027
	(0.022)	(0.031)	(0.023)
N	121,000	121,000	2,104,000
IV	✓	✓	✓
F stat (indirect x Z_f)	444.6	1082	31.4
Controls	✓	✓	✓
County FE	✓	✓	✓
Industry FE	SIC 4-digit	SIC 4-digit	SIC 4-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ is the establishment-level employment growth defined in (2.7). $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (2.5). Capital and skill intensities are based on the NBER-CES Manufacturing Database. Capital intensity is the ratio of capital to total employment, and skill intensity is the ratio of non-production workers to total number of employees. Firm-level leverage in column (3) is sourced from Compustat and is equal to the ratio of total debt (short- and long-term) to total assets. Controls include manufacturing employment share, establishment age and age-squared, firm age and age-squared, log of initial establishment employment, log of initial firm employment, log of initial sector employment within firm, log of average initial employment in other establishments within firm. All regressions are weighted by initial establishment-level employment. Standard errors are double clustered at the state and firm level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.

A.5 Sectoral Aggregate Impact of Direct and Indirect China Shocks on Overall Employment Growth

Table A.16: Sectoral Aggregate Impact of Direct and Indirect China Shocks on Overall Employment Growth

	$\widetilde{\Delta}\text{Emp}_{(91-07)}$				
Margin	Overall	Overall	Exit	Intensive	Entry
$\widetilde{\Delta}\text{IP}_{(91-07)}$	-0.110**	-0.110**	-0.025*	-0.026	-0.060*
	(0.047)	(0.047)	(0.014)	(0.018)	(0.036)
$\widetilde{\Delta}\text{IP}_{(91-07)}$ (other)		0.044	-0.276*	0.094	0.226
		(0.33)	(0.167)	(0.219)	(0.273)
N	850	850	850	850	850
IV	✓	✓	✓	✓	✓
F stat (direct)	39.8	41.8	41.8	41.8	41.8
F stat (indirect)		120	120	120	120
Controls	✓	✓	✓	✓	✓
Industry FE	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 2-digit	SIC 2-digit

Notes: $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Overall) is the sector-level employment growth. $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Exit) indicates sector-level employment growth from establishment closures, $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Intensive) indicates sector-level employment growth from continuing establishments, and $\widetilde{\Delta}\text{Emp}_{(91-07)}$ (Entry) indicates sector-level employment growth from establishment entry. $\widetilde{\Delta}\text{IP}_{(91-07)}$ is the direct China shock defined in (2.2) and $\widetilde{\Delta}\text{IP}_{(91-07)}$ (other) is the indirect China shock defined in (5.1). Controls include the logarithm of initial employment and the share of the industry-level employment accounted for in the baseline sample described in Section 3.2. All regressions are weighted by initial sector-level employment. Standard errors are clustered at the SIC 2-digit level. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. All numbers have been rounded in accordance with U.S. Census Bureau disclosure guidelines.